



Frederick County Stream Survey 2008-2010 Countywide Results



Prepared for

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INTRODUCTION

Freshwater streams are highly valued natural ecosystems that provide clean water and support fish and other aquatic life. Frederick County, Maryland, has initiated a stream monitoring and assessment program to collect information on the health of the County's streams. Findings will be used to help guide the County's watershed management programs to better protect and restore local waters.

The Frederick County Stream Survey (FCSS) is a program to assess the status of County streams in terms of water quality, biological condition, and habitat. The survey employs a statistical design, using a random sampling approach to draw inferences about stream condition in each of the County's 20 watersheds and in larger areas such as the Lower Monocacy watershed and the entire County. The FCSS was designed to answer key questions about the condition of Frederick County's watersheds and streams and, in particular, the stressors affecting those streams. The site selection and stream sampling methods are based on Maryland Department of Natural Resources' Maryland Biological Stream Survey (MBSS).

In 2007, a Pilot Study was launched in the Bennett and Catoctin Creek watersheds to help develop, test, and refine the design and sampling protocols for the full FCSS (Versar Inc. 2009). The first round of the FCSS began in 2008 and will continue through 2011. For each of the 2008-2010 sampling years, field crews contacted landowners and sampled 50 randomly selected sites stratified across the 20 watersheds in the County. Following methods detailed in the design report (Perot, et al. 2008), data were collected on water quality, physical habitat, and biological communities at each of the stream sites. This information was used to

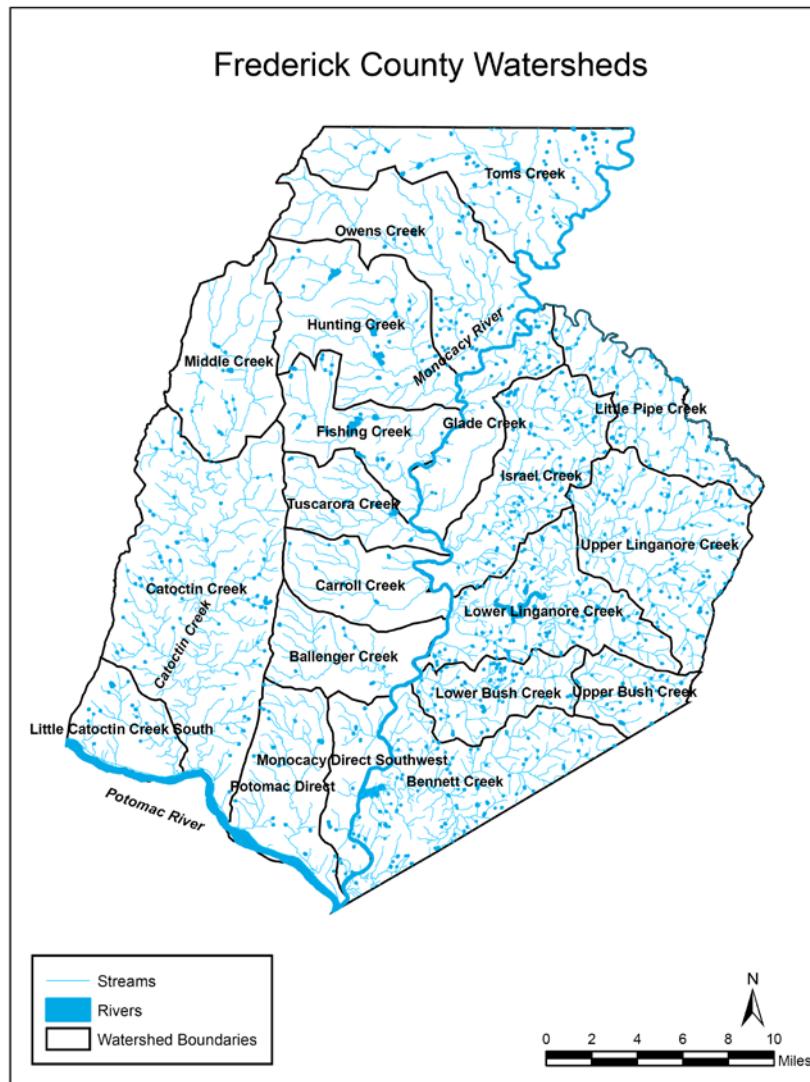


Figure 1. Watershed boundaries in Frederick County

make an assessment of stream conditions Countywide. Because the sites were randomly selected, estimates of the extent of streams (percentage of stream miles) in different condition classes for each assessment measure could be made.

This report presents the key findings from the combined 2008-2010 sample years, including answers to each of 10 study questions. Additional information including site specific data are included in the Appendix to this report. The FCSS will ultimately provide information on stream condition and related stressors by individual watershed, in addition to the Countywide information provided every year.

Overall, biological condition of streams in Frederick County was rated as fair, which is a slight improvement from the 2008-2009 results where biological condition was rated as poor. Stream condition was affected by a variety of land use, habitat, and water quality factors. Stream condition results and an assessment of key stressors are highlighted in the following sections:

- Land Use
- Habitat
- Water Quality
- Biological Condition
- Stressors

2008-2010 FCSS RESULTS

Land Use

Watershed land use is an indicator of how human activities affect a stream. A watershed is an area of land that drains to a particular body of water. Watersheds form natural geographic units for assessing impacts on streams because land use within the watershed upstream of a specific stream site is representative of many of the human activities affecting the stream at that point.

Conversion of naturally vegetated lands to urban and agricultural uses can result in serious impacts to streams and their aquatic inhabitants. In urban and suburban areas, impervious surfaces, such as roads, parking lots, sidewalks, and rooftops, cause a rapid increase in the rate that water is transported from the watershed to its stream channels. Effects include an increase in the variability of stream flows (more “flashy” flows), increased streambank erosion, habitat degradation caused by channel instability, increased pollutant runoff, elevated temperatures, and losses of biological diversity. Reviews of stream research in numerous watersheds indicate that impacts on stream quality are commonly noted at about 10% coverage by impervious surface (Schueler et al. 2009). Effects on sensitive species may occur at even lower levels (Roth et



al. 1999). Agricultural impacts upon stream resources can include runoff of sediment, nutrients, and other pollutants, and increased erosion leading to habitat and water quality degradation, but agricultural effects may be complex, as they may include contributions of lime (which can neutralize harmful acid rain inputs) and nutrients (which can, in some cases, enhance stream productivity).

Frederick County has a diverse mix of land uses. Overall, 48% of the County is agriculture, 33% is forest, and 17% is urban/suburban (2% is “other”, including wetlands/water and barren lands).

In the FCSS, land uses were characterized within the individual catchment areas upstream of sampled sites. An estimated 53% of stream miles in the County had greater than 10% urban land use in their catchments. Additionally, 23% of stream miles had greater than 25% urban land use. The streams with the greatest urban land use were those located in and around the City of Frederick, as well as along the highly developed I-270 corridor. These results indicate that a substantial proportion of Frederick County streams are vulnerable to the harmful consequences of urbanization described above.

The extent of forested land was also characterized. For a comparison, in a study which established reference and degraded conditions for streamside salamanders (an indicator of stream conditions, Southerland et al. 2004), streams with greater than or equal to 75% forested land use in upstream catchments were considered as high-quality reference streams and streams with less than or equal to 10% forested land use in upstream catchments were considered degraded. In Frederick County in 2008-2010, only 17% of stream miles had greater than or equal to 75% forested land use upstream, while 25% of stream miles had less than or equal to 10% forested land use upstream (including 3 sites with no forested land use in their upstream catchments). In all, 7% of stream miles had more than 90% agriculture in upstream catchments. The average percentage of catchment area as agriculture was 45%, compared with an average of 18% urban and 37% forest.



Habitat



Stream health, as determined by the condition of biological communities, is often directly correlated to the quality of physical habitat within a stream. Habitat loss and degradation have been identified as critical factors affecting biological diversity in streams worldwide. Habitat degradation can result from a variety of human impacts occurring within the stream itself or in the surrounding watershed. Typical instream impacts include sedimentation, channelization, and bank erosion. Urban development, timber harvesting, agriculture,

livestock grazing, and the draining or filling of wetlands are well-known examples of human activities affecting stream habitat at the watershed scale.

These human activities may cause changes in vegetative cover, sediment loads, hydrology, and other factors influencing stream habitat quality. The amount of forest, meadow, and other vegetative cover in a watershed regulates the flow of water, nutrients, and sediments to adjacent streams. In watersheds affected by human land uses, riparian (streamside) forests can act as a filter, reducing the amounts of nutrients, sediments, and other pollutants reaching streams. They also provide local benefits of shade, leaf litter to feed the aquatic food web, and large woody debris, which in turn provides cover and forms pool and riffle microhabitats preferred by fish and other aquatic animals. The loss of watershed or riparian vegetation increases the potential for overland and channel erosion, often increasing the siltation of stream bottoms and obliterating the clean gravel surfaces used by many fish species as spawning habitat. Stream bottoms that become embedded with increased sediment offer poor habitat for many bottom-dwelling species. The impervious surfaces of urban areas and the direct connection of runoff to storm water pipes or channelized streams alter runoff patterns and creates "flashy" streams with more extreme high and low flows, increased scouring, and streambank erosion. These altered flows accelerate downcutting and widening of stream channels.



The FCSS collects data on many aspects of physical habitat, including the extent and type of vegetated riparian buffer, the severity of bank erosion observed, and an overall indicator of habitat quality. The Physical Habitat Index (PHI) for Maryland streams was developed using data from the Maryland Biological Stream Survey (Paul et al., 2002). This index combines several measures of physical habitat characteristics into one value that is then compared to minimally impacted ("reference") sites throughout the state.

What percentage of stream miles lack vegetated riparian buffers?

For the purposes of this report, the riparian buffer width on both sides of the stream was summed together as a measure of riparian buffer integrity. Fifteen percent of stream miles in the County had vegetated riparian buffer widths less than 15 meters, while 69% of stream miles in the County had vegetated riparian buffers of at least 60 meters. An ideal width depends upon what functions are expected of the riparian buffer. Watershed and site characteristics, as well as those of the buffer itself, must be taken into account when determining an ideal buffer width.

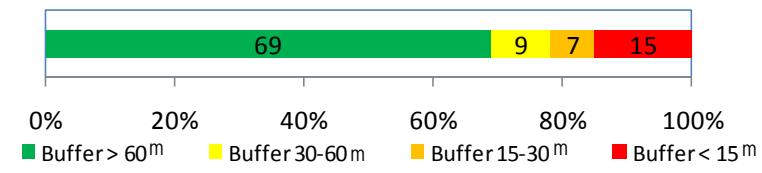


Figure 2. Riparian buffer width 2008-2010, Frederick County

What percentage of stream miles exhibit severe bank erosion?

In 2008-2010, only 10% of stream miles in the County showed no indications of bank erosion, while 25% of stream miles exhibited severe erosion, based on the height and extent of the erosion (Figure 3).

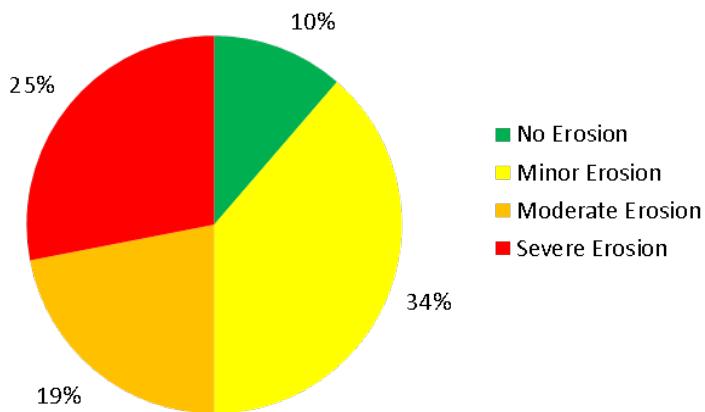


Figure 3. Frederick County 2008-2010 bank erosion

In 2008-2010, 19% of stream miles in the County were rated as Severely Degraded and 25% were Marginally Degraded based on the Physical Habitat Indicator. (Figure 4; see Appendix for scoring ranges.)

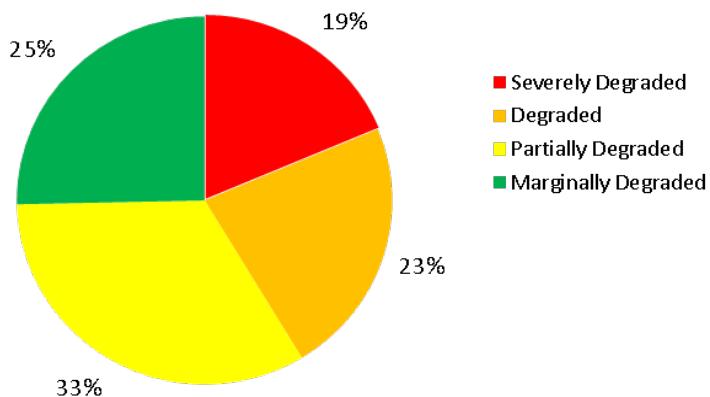


Figure 4. Frederick County 2008-2010 Physical Habitat Indicator

Water Quality

Nutrients such as nitrogen and phosphorus are important for life in all aquatic systems. In the absence of human influence, streams contain background levels of nutrients that are essential to the survival of the aquatic plants and animals. However, since the time of European settlement, the amount of nitrogen and phosphorus in many North American stream systems has

increased, as a result of human influences such as agricultural runoff, wastewater discharge, and urban/suburban runoff.

Elevated nitrogen is one contributor to nutrient enrichment in Frederick County streams. Excessive nitrogen loading may lead to the eutrophication of a water body, particularly in downstream estuaries like the Potomac River and Chesapeake Bay. Eutrophication can cause algal blooms, which can lead to decreased levels of dissolved oxygen in the water. Prolonged exposure to low dissolved oxygen conditions can asphyxiate fish, shellfish, and other animals.



Estimates of nitrogen sources in Maryland, as presented in the Chesapeake Bay TMDL (Chesapeake Bay Phase 5.2 Watershed model, 2008 Scenario), are that 36% is from agricultural sources, 29% from developed land, 10% from forest, and 25% from wastewater treatment plants.

The FCSS records field measures of dissolved oxygen and other water quality parameters and collects water samples for laboratory analysis of nitrogen and phosphorus.

What percentage of stream miles have dissolved oxygen less than the state water quality standard at the time of sampling?

The state water quality standard for dissolved oxygen is 5 mg/l. Based on spring 2008-2010 sampling, no stream miles in Frederick County had a dissolved oxygen level less than 5 mg/l at the time of sampling (Figure 5). Sampling occurred once at each site during March-April 2008, 2009, and 2010. While dissolved oxygen may be lower during a summer sampling event, Maryland streams tend to have dissolved oxygen values higher than 5 mg/L.

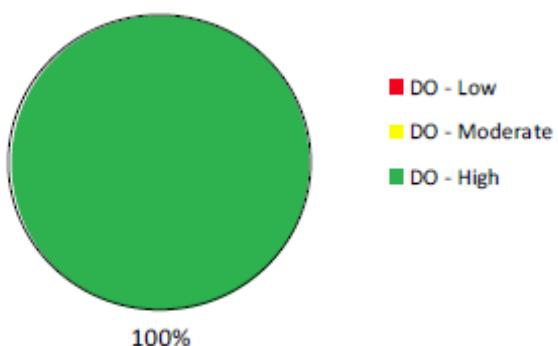


Figure 5. Frederick County 2008-2010 Dissolved Oxygen

What is the geographic distribution of streams with high amounts of Total Nitrogen?

The northwestern portion of the County, where forested land use is greatest (Figure 6), seemed to have slightly lower concentrations of Total Nitrogen than the easternmost portion.

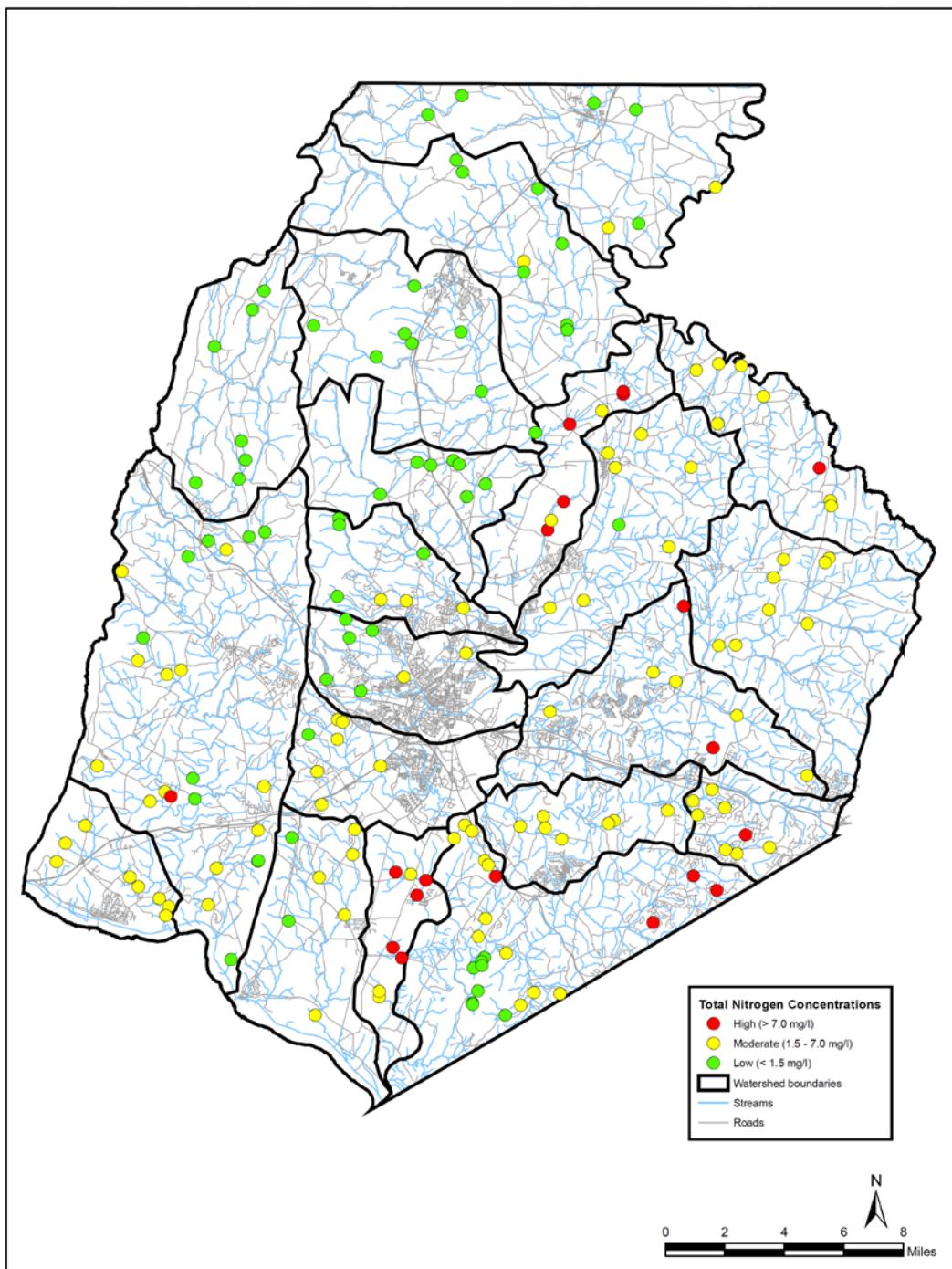


Figure 6. Nitrogen at sites sampled by the FCSS 2008-2010

Stream Biological Community (adapted from DNR 2004)

Freshwater benthic macroinvertebrates are bottom-dwelling aquatic animals without backbones that are larger than 0.5 millimeters long. These animals live in water on rocks, logs, sediment, debris and aquatic plants during some period in their life. Stream benthic macroinvertebrates include crustaceans such as crayfish, mollusks such as clams and snails, aquatic worms, and the immature forms of aquatic insects such as stonefly and mayfly nymphs.



Benthic macroinvertebrates are an important part of the food chain. Many invertebrates feed on algae and bacteria, which are on the lower end of the food chain. Some shred and eat leaves and other organic matter that enters the water. Because of their abundance and position as “middlemen” in the aquatic food chain, benthic macroinvertebrates play a critical role in the natural flow of energy and nutrients. As they die, they decay, leaving behind nutrients that are reused by aquatic plants and other animals in the food chain.

Unlike fish, benthic macroinvertebrates cannot move around much, so they are less able to escape the effects of sediment and other pollutants that diminish water quality and degrade habitat. Therefore, benthic macroinvertebrates can provide reliable information on stream degradation. Benthic macroinvertebrates represent an extremely diverse group of aquatic animals and the large number of species possess a wide range of responses to stressors such as organic pollutants, sediments, and toxic chemicals. They can serve as an early warning sign of declines in environmental quality.

The Benthic Index of Biotic Integrity (benthic IBI or BIBI) is a stream assessment tool that evaluates stream biological integrity based on characteristics of the various benthic organisms present at a site. Biological integrity is defined as the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region (Karr and Dudley 1981).

Frederick County sites were evaluated using the benthic IBI developed for the Maryland Biological Stream Survey (for detailed methods, see Southerland, et al. 2005). IBI scores are determined by comparing the benthic assemblages at each site to those found at minimally impacted (“reference”) sites within the same region. Site-specific IBI results were used to estimate the extent of streams within the study watersheds that were in good, fair, poor, and very poor condition with respect to the biotic integrity of the benthic community.

What percentage of stream miles are in very poor, poor, fair, or good condition according to the benthic IBI?

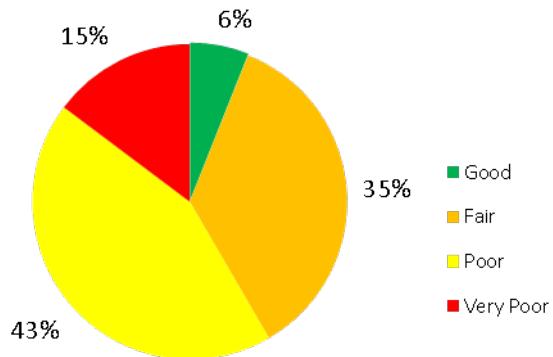


Figure 7. Frederick County 2008-2010 Benthic IBI

The benthic IBI average score for the County was 3.02 (Fair), with Scores spread throughout the County. Six percent of stream miles scored Very Poor, 35% scoring Poor, 43% scored Fair, and only 15% of stream miles scored Good (Figure 7; see Appendix for scoring ranges).

Benthic IBI scores were evenly distributed throughout the County, with no one area having a concentration of very high or very low scores (Figure 8).

What percentage of stream miles have suitable physical habitat and would be expected to have desired species if other stressors were absent (i.e., are good candidates for restoration)?

The relationship between Physical Habitat Indicator Score and BIBI was not a strong one ($r^2 = 0.03$; Figure 9), in the 2008-2010 FCSS. As would be expected, many sites with good PHI scores had Fair or Good BIBI scores. But, there were also many sites that were an exception to this relationship. For example, of the seven sites with PHI scores greater than 90, five had BIBI scores less than or equal to 3.00 (see Appendix for these sites). These sites may be good sites for restoration, given the potential that BIBI scores might improve in the absence of other stressors.

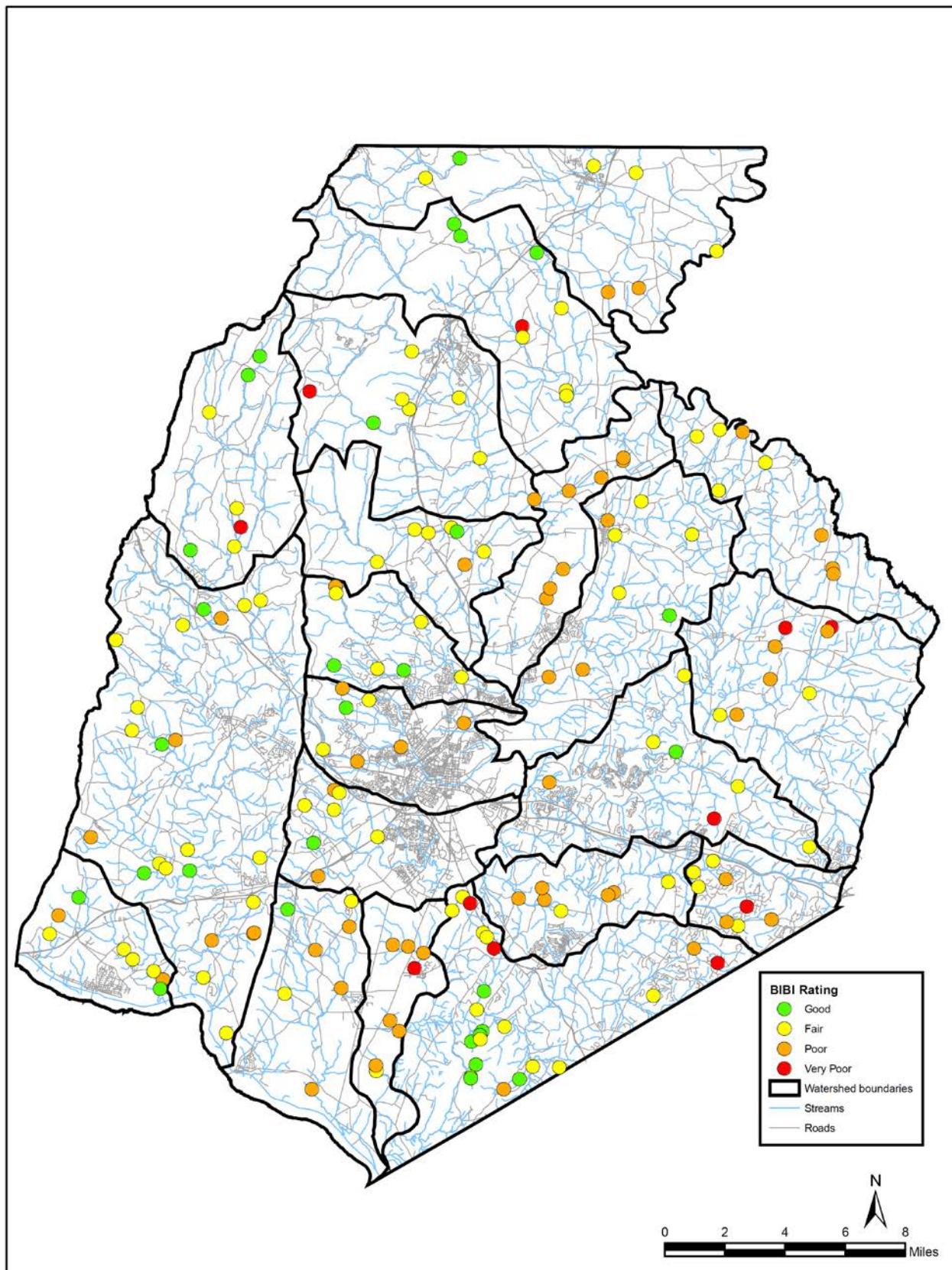


Figure 8. Benthic macroinvertebrate Index of Biotic Integrity scores for the FCSS 2008-2010

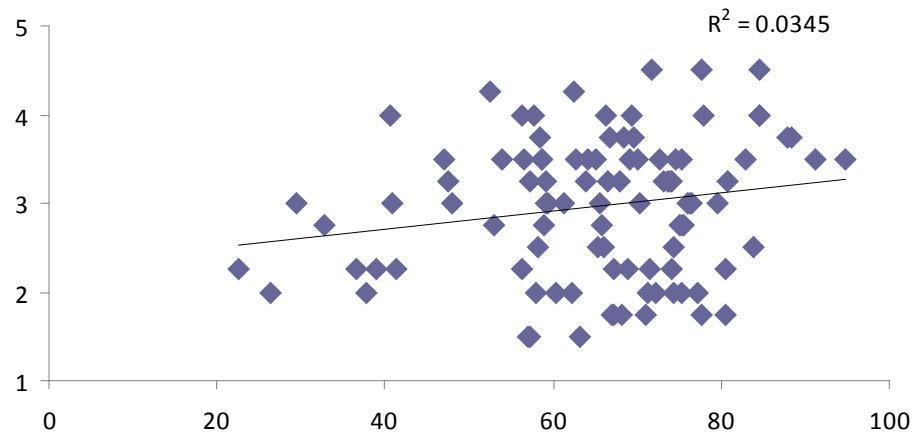


Figure 9. Frederick County 2008-2010 PHI vs. BIBI

In the 2008-2010 FCSS, the relationship between urban land use in the catchments upstream of the sample sites and the BIBI at those sites was not significant ($r^2 = 0.02$). This result is most likely due to the fact that there were not many sites with high amounts of urban land in the upstream catchments, however, the relationships of agricultural land use and forested land use to BIBI ($r^2=0.16$ and $r^2=0.25$ and Figures 10 and 11, respectively) did show obvious trends. As might be expected, BIBI scores decreased with greater agricultural land use and increased with greater forested land use.

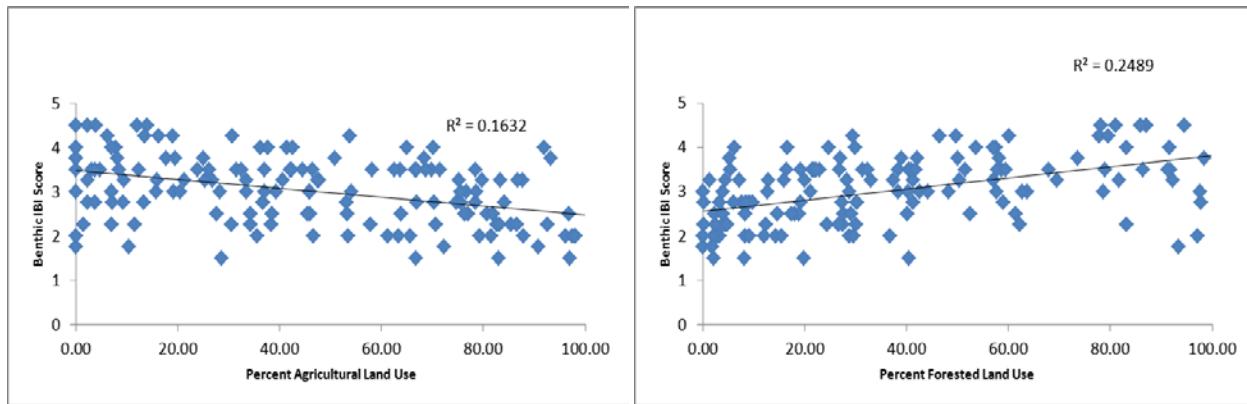


Figure 10. Frederick County 2008-2010 Agricultural Land Use

Figure 11. Frederick County 2008-2010 Forested Land Use vs. BIBI

What percentage of stream miles that are in good condition are near the thresholds of impervious surface likely to cause degradation (i.e., are most vulnerable)?

Impervious surfaces are mainly constructed surfaces - rooftops, sidewalks, roads, and parking lots – covered by impenetrable materials such as asphalt, concrete, brick, and stone.

These materials seal surfaces, repel water and prevent precipitation and meltwater from infiltrating soils. Soils compacted by urban development are also highly impervious. Impervious surfaces increase runoff, reduce evapotranspiration, have high thermal conductivities, and contribute to non-point source pollution problems. As a rule, water quality problems increase with increased impervious surface cover, leading to degraded stream conditions (http://chesapeake.towson.edu/landscape/impervious/what_imp2.asp). Schueler et al. (2009) define four categories of urban streams based on how much impervious surface exists in their upstream catchment:

- Sensitive – less than 10% impervious surface in the upstream catchment, are generally able to maintain their hydrologic function and support good to excellent aquatic diversity;
- Impacted – 10 to 25% impervious surface in the upstream catchment, show clear signs of declining stream health;
- Non-supporting – 25 to 60% impervious surface, no longer support their designated uses in terms of hydrology, channel stability, habitat, water quality, or biological diversity. They have become so degraded that it may be difficult to fully recover predevelopment stream function; and
- Urban drainage – greater than 60% impervious surface and basically just function as conduits for floodwater, they consistently have poor habitat and biodiversity scores.

In the 2008-2010 FCSS, the average percent imperviousness in catchments upstream of sample sites was 6%, well below the threshold for sensitive streams. Impervious surface values ranged from 1.5% to 61%. Based on the characterization of upstream catchment land use, an estimated 92% of stream miles in the County fell into the “sensitive” streams category, while 6% of stream miles were “impacted”. One percent of stream miles were “non-supporting”. One percent of the stream miles fell into the urban drainage category as well.

In 2008-2010, 12 sites had impervious surface values in their upstream catchments greater than 10%. Eight of these sites were rated Poor, and four sites were rated Fair. At these sites especially, just a small increase in the impervious surface in the upstream catchment could result in a dramatic worsening in stream conditions.

Stressor Analysis

In order to aid the State of Maryland in the establishment of ways to improve waters that have been identified as impaired (through, for example, development of Total Maximum Daily Loads [TMDLs]), the Maryland Department of the Environment (MDE) has recently developed a method for identifying likely stressors to Maryland waters based on the MBSS data (Southerland et al. 2007). This stressor identification method involves two steps: 1. Stream disturbance index scores for three stressor types (flow/sediment, energy source, and inorganic pollutants) are calculated for each site, and 2. Index scores for each stressor type are averaged across all sites in the County and the likelihood of each stressor type affecting the streams is defined as none, low, moderate, or high.

This method was applied to the data collected in the FCSS. Results can be used to highlight the general types of stressors affecting the streams in Frederick County.

What are the specific stressor types (flow/sediment, energy source, inorganic pollutants affecting the county and to what degree are they prevalent?

For Frederick County as a whole in 2008-2010, sites scored High for flow/sediment and for inorganic pollutant stressors and None for energy source stressors. A more detailed breakdown of stressor types by watershed will be provided once the four-year survey is completed.

FUTURE

The FCSS continues with annual sampling through 2011.

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APPENDIX

Table Appendix-1. BIBI and PHI scores for sites sampled in the FCSS 2007-2010

Site	PHI	B-IBI	Site	PHI	B-IBI
2007					
BENN-130-R-2007	28.79	1.5	BENN-108-R-2007	90.62	3
BENN-217-R-2007	42.82	3	BENN-113-R-2007	62.36	3.25
BENN-218-R-2007	57.11	3.5	BENN-127-R-2007	74.22	4.25
CATO-108-R-2007	54.89	3.75	BENN-132-R-2007	73.71	4
CATO-117-R-2007	93.88	3.25	CATO-112-R-2007	61.93	2.5
CATO-121-R-2007	72.07	3.25	CATO-118-R-2007	48.45	2.75
CATO-127-R-2007	91.73	2.25	CATO-120-R-2007	73.27	3.75
BENN-103-R-2007	69.39	2.5	CATO-302-R-2007	86.83	4
BENN-111-R-2007	54.39	3	BENN-106-R-2007	77.04	4
BENN-201-R-2007	64.30	3	BENN-129-R-2007	66.30	4.25
BENN-215-R-2007	66.97	4	BENN-133-R-2007	77.92	3.75
CATO-103-R-2007	51.19	3.5	BENN-225-R-2007	66.34	1.75
CATO-110-R-2007	82.00	3.25	CATO-116-R-2007	63.29	2.25
CATO-428-R-2007	92.44	3	CATO-205-R-2007	68.83	3.5
CATO-504-R-2007	76.64	4	CATO-230-R-2007	70.87	3.5
2008					
LINL-103-R-2008	59.78	3.5	LINU-407-R-2008	66.37	3
FISH-201-R-2008	58.90	3.25	CATO-102-R-2008	87.66	3.5
FISH-203-R-2008	65.38	3.75	HUNT-105-R-2008	95.65	1.75
HUNT-302-R-2008	45.93	3	MIDD-101-R-2008	67.22	1.5
TOMS-202-R-2008	88.13	3.25	MIDD-109-R-2008	53.51	3.5
TOMS-401-R-2008	67.52	2.5	BENN-105-R-2008	58.77	1.75
HUNT-303-R-2008	90.27	3	BENN-204-R-2008	89.07	3.75
ISRA-301-R-2008	29.61	2.25	BUSL-301-R-2008	87.47	2.75
LIPI-201-R-2008	38.20	3	BUSU-206-R-2008	82.16	3.25
BENN-101-R-2008	78.07	2.75	GLAD-109-R-2008	50.96	2
BUSL-107-R-2008	60.23	3.5	OWEN-302-R-2008	73.82	3.5
POTD-205-R-2008	17.49	2	OWEN-309-R-2008	58.58	3
POTD-301-R-2008	31.53	2	CARR-106-R-2008	71.70	3
BALL-102-R-2008	77.60	2.75	CATO-405-R-2008	56.22	3
LCCS-101-R-2008	76.45	3.25	OWEN-101-R-2008	39.02	1.75
LCCS-103-R-2008	75.34	2	BUSU-104-R-2008	76.05	3
LCCS-202-R-2008	80.89	2.75	BUSU-109-R-2008	67.31	1.75
BALL-105-R-2008	62.10	3	MODS-108-R-2008	82.35	2.5
CATO-204-R-2008	88.43	2.75	ISRA-107-R-2008	77.95	3.5
GLAD-108-R-2008	73.77	2.25	ISRA-109-R-2008	77.04	3.25
TUSC-107-R-2008	83.66	3.5	LIPI-102-R-2008	49.07	2
TUSC-406-R-2008	47.05	3	LIPI-307-R-2008	48.41	2
LINL-104-R-2008	73.52	4	CARR-111-R-2008	88.55	4.5
LINU-111-R-2008	58.61	1.5	MODS-110-R-2008	65.85	3.75
LINU-405-R-2008	82.36	2.5	MODS-115-R-2008	39.74	2

Table Appendix-1. (Continued)

Site	PHI	B-IBI	Site	PHI	B-IBI
2009					
BALL-126-R-2009	87.82	3.75	BUSU-227-R-2009	66.39	3.25
CATO-132-R-2009	94.78	3.5	LINL-126-R-2009	57.11	1.5
CATO-135-R-2009	58.65	3.5	BUSL-322-R-2009	80.47	2.25
CARR-129-R-2009	68.51	3.75	BUSL-330-R-2009	65.99	2.5
CARR-135-R-2009	71.38	2.25	LINL-423-R-2009	57.88	2
CARR-222-R-2009	74.14	2.25	LINL-429-R-2009	72.69	3.5
BALL-123-R-2009	22.61	2.25	LINU-134-R-2009	75.41	2
BALL-127-R-2009	88.35	3.75	TOMS-224-R-2009	74.20	3.25
HUNT-225-R-2009	77.73	4.5	TOMS-234-R-2009	57.14	3.25
ISRA-129-R-2009	37.87	2	TOMS-325-R-2009	62.37	4.25
LCCS-125-R-2009	40.62	4	MODS-121-R-2009	38.99	2.25
LCCS-226-R-2009	78.01	4	MODS-124-R-2009	71.01	1.75
LIPI-128-R-2009	47.61	3.25	OWEN-224-R-2009	80.70	3.25
LIPI-234-R-2009	41.25	2.25	POTD-132-R-2009	48.03	3
MIDD-126-R-2009	84.49	4	POTD-328-R-2009	83.82	2.5
MIDD-135-R-2009	71.70	4.5	TUSC-121-R-2009	69.30	4
TUSC-432-R-2009	58.35	3.75	TUSC-231-R-2009	52.61	4.25
GLAD-126-R-2009	75.19	2.75	FISH-222-R-2009	53.89	3.5
GLAD-128-R-2009	36.49	2.25	FISH-224-R-2009	73.55	3.25
GLAD-129-R-2009	32.72	2.75	FISH-226-R-2009	62.67	3.5
HUNT-133-R-2009	84.08	3.75	ISRA-226-R-2009	70.07	3.5
BENN-130-R-2009	84.49	4	LINU-121-R-2009	26.36	2
BENN-427-R-2009	82.89	3.5	MIDD-124-R-2009	46.95	3.5
BUSL-324-R-2009	67.12	2.25	OWEN-122-R-2009	57.69	4
BUSU-126-R-2009	65.52	3	POTD-133-R-2009	58.63	3.5
2010					
GLAD-139-R-2010	54.73	2.5	LINL-138-R-2010	77.10	3.25
BALL-148-R-2010	63.05	4.25	LINU-142-R-2010	67.64	1.5
BALL-149-R-2010	83.79	3	LINU-145-R-2010	48.93	2.75
BUSL-341-R-2010	91.31	2.75	LINU-239-R-2010	60.29	3
GLAD-141-R-2010	56.15	2	MODS-140-R-2010	52.21	2.5
ISRA-137-R-2010	83.02	4.25	MODS-245-R-2010	62.56	2
BUSU-141-R-2010	53.40	2.75	MODS-246-R-2010	50.44	2.75
FISH-144-R-2010	91.65	2.25	POTD-139-R-2010	41.31	2.75
FISH-243-R-2010	71.38	4.25	POTD-141-R-2010	82.86	4.5
ISRA-142-R-2010	85.19	3.75	LIPI-145-R-2010	52.02	3
ISRA-149-R-2010	45.56	2.25	LIPI-149-R-2010	71.40	3.25
BUSL-137-R-2010	78.32	3.25	LIPI-150-R-2010	53.50	2.5
BUSU-149-R-2010	57.26	2.75	TOMS-241-R-2010	71.11	2.5
BUSU-236-R-2010	67.25	2.5	TOMS-337-R-2010	73.68	3.25
LINL-137-R-2010	31.92	3.5	BENN-149-R-2010	94.14	4

Table Appendix-1. (Continued)

Site	PHI	B-IBI	Site	PHI	B-IBI
2010 (Continued)					
BENN-150-R-2010	65.77	3.5	LCCS-245-R-2010	73.02	3.5
BENN-440-R-2010	45.45	3.5	MIDD-136-R-2010	84.87	4
OWEN-348-R-2010	75.73	3.5	MIDD-338-R-2010	59.27	3.5
TUSC-143-R-2010	89.68	3	OWEN-145-R-2010	70.75	4.5
TUSC-150-R-2010	85.20	2	OWEN-147-R-2010	82.81	4.25
CATO-144-R-2010	93.84	2.5	HUNT-249-R-2010	68.79	3.5
CATO-238-R-2010	88.16	4	CARR-141-R-2010	42.02	2.25
LCCS-248-R-2010	66.53	3.5	CARR-143-R-2010	47.75	2.75
CATO-337-R-2010	82.79	4	HUNT-539-R-2010	64.18	2.5
LCCS-241-R-2010	75.47	3.5	HUNT-144-R-2010	82.03	3.75

Table Appendix-2. Thresholds for condition classes (Good, Fair, Poor, Very Poor) for BIBI and PHI scores in accordance with MBSS.

Condition Class	BIBI Range	PHI Range	Description (Roth et al. 1999)
Good/Marginally Degraded	4.0 – 5.0	81 – 100	Comparable to reference streams considered to be minimally impacted.
Fair/ Partially Degraded	3.0 – 3.9	66-80	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
Poor/ Degraded	2.0 – 2.9	51-65	Significant deviation from reference conditions, with many aspects of biological integrity not resembling the qualities of minimally impacted streams.
Very Poor/Severely Degraded	1.0 – 1.9	0-50	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams.

Table Appendix-3. Upstream catchment land use for sites sampled for the FCSS 2007-2010 (based on Maryland Department of Planning 2007 and PASDA 2005 data)

Site	% Urban	% Agricultural	% Forest	% Wetlands	% Water	% Other
2007						
BENN-103-R-2007	7.77	76.85	15.40			
BENN-106-R-2007			100.03			
BENN-108-R-2007			100.03			
BENN-111-R-2007	94.82	0.03	5.17			
BENN-113-R-2007			100.03			
BENN-127-R-2007		1.90	98.13			
BENN-129-R-2007			100.03			
BENN-130-R-2007	21.39	68.10	10.54			
BENN-132-R-2007			100.03			
BENN-133-R-2007	7.69	43.32	49.02			
BENN-201-R-2007	5.16	88.69	6.18			
BENN-215-R-2007		22.98	77.05			
BENN-217-R-2007	6.33	68.01	25.69			
BENN-218-R-2007	7.13	69.88	23.02			
BENN-225-R-2007	44.13	41.45	13.95		0.50	
CATO-103-R-2007	24.19	46.20	29.65			
CATO-108-R-2007	19.37	23.36	57.31			
CATO-110-R-2007	8.27	91.78				
CATO-112-R-2007	88.11	11.93				
CATO-116-R-2007	93.79	1.37	4.89			
CATO-117-R-2007		42.88	57.16			
CATO-118-R-2007	4.80	93.83	1.43			
CATO-120-R-2007	0.69	27.56	71.79			
CATO-121-R-2007	10.37	47.71	41.96			
CATO-127-R-2007	0.19	53.12	46.73			
CATO-205-R-2007	9.55	27.58	62.90			
CATO-230-R-2007	5.57	41.67	52.80			
CATO-302-R-2007	8.45	88.87	2.72			
CATO-428-R-2007	9.68	65.81	24.55		0.01	
CATO-504-R-2007	15.66	46.71	37.63		0.04	
2008						
BALL-102-R-2008	45.45	13.24	41.34			
BALL-105-R-2008	19.24	76.67	3.84		0.29	
BENN-101-R-2008		2.28	97.75			
BENN-105-R-2008		100.03				
BENN-204-R-2008	7.05	50.78	42.00		0.19	
BUSL-107-R-2008	25.98	68.73	5.31			
BUSL-301-R-2008	32.77	36.68	30.18		0.08	0.31
BUSU-104-R-2008	45.41	33.48	21.12			
BUSU-109-R-2008	89.64	10.38				
BUSU-206-R-2008	40.03	26.81	32.93			0.25
CARR-106-R-2008	29.28	7.03	63.72			
CARR-111-R-2008	13.00		87.03			
CATO-102-R-2008	3.51	4.73	91.80			
CATO-204-R-2008	19.57	53.10	27.28		0.08	
CATO-405-R-2008	15.81	45.90	38.29		0.04	
FISH-201-R-2008	5.16	2.31	92.34		0.22	
FISH-203-R-2008	1.25	0.01	98.49		0.27	
GLAD-108-R-2008	9.45	86.62	3.94			
GLAD-109-R-2008	17.85	79.35	2.81			

Table Appendix-3. (Continued)

Site	% Urban	% Agricultural	% Forest	% Wetlands	% Water	% Other
2008 (Continued)						
HUNT-105-R-2008	6.68		93.34			
HUNT-302-R-2008	16.44	20.53	62.70		0.36	
HUNT-303-R-2008	13.78	7.06	78.69		0.49	
ISRA-107-R-2008	5.13	78.54	16.34			
ISRA-109-R-2008	23.91	47.78	28.32			
ISRA-301-R-2008	15.48	57.91	26.58		0.05	
LCCS-101-R-2008	3.40	79.83	15.93		0.89	
LCCS-103-R-2008		63.30	36.75			
LCCS-202-R-2008	10.26	70.33	19.10		0.36	
LINL-103-R-2008	9.41	71.49	19.11			
LINL-104-R-2008		42.58	57.44			
LINU-111-R-2008	0.84	97.05	2.11			
LINU-405-R-2008	17.27	53.32	29.15	0.05	0.12	0.10
LINU-407-R-2008	16.98	54.06	28.71	0.05	0.12	0.10
LIPI-102-R-2008	0.41	97.52	2.07			
LIPI-201-R-2008	8.65	78.62	12.70		0.04	
LIPI-307-R-2008	3.73	87.91	8.36			
MIDD-101-R-2008	13.48	66.74	19.81			
MIDD-109-R-2008	17.09	31.45	51.48		0.01	
MODS-108-R-2008	0.94	96.80	2.29			
MODS-110-R-2008	1.52	93.33	5.19			
MODS-115-R-2008	1.96	98.05	0.02			
OWEN-101-R-2008	7.37	90.80	1.84			
OWEN-302-R-2008	5.18	36.99	57.76		0.08	
OWEN-309-R-2008	5.28	37.05	57.60		0.08	
POTD-205-R-2008	23.85	46.59	29.60			
POTD-301-R-2008	23.05	61.30	15.49		0.19	
TOMS-202-R-2008	9.44	33.43	57.09		0.06	
TOMS-401-R-2008	13.20	45.48	40.19	0.02	0.70	0.24
TUSC-107-R-2008	54.56	3.71	41.77			
TUSC-406-R-2008	23.35	28.28	48.20		0.19	
2009						
BALL-123-R-2009	25.97	11.50	62.29		0.28	
BALL-126-R-2009	41.54	19.54	38.96			
BALL-127-R-2009	33.80	8.10	58.14			
BENN-130-R-2009	41.64	41.50	16.55		0.34	
BENN-427-R-2009	17.02	42.39	40.45		0.09	0.08
BUSL-322-R-2009	38.16	34.23	27.48		0.07	0.07
BUSL-324-R-2009	30.23	38.28	29.99		0.06	1.46
BUSL-330-R-2009	37.98	34.23	27.66		0.07	0.07
BUSU-126-R-2009	84.29	15.69	0.04			
BUSU-227-R-2009	37.20	25.31	37.30			0.21
CARR-129-R-2009	25.02	25.06	49.95			
CARR-135-R-2009	9.99	6.93	83.11			
CARR-222-R-2009	44.86	30.50	24.36		0.31	
CATO-132-R-2009	61.74		38.31			
CATO-135-R-2009	12.59	46.54	40.91			
FISH-222-R-2009	8.45	12.38	78.99		0.20	
FISH-224-R-2009	9.03	21.26	69.57		0.17	
FISH-226-R-2009	5.41	3.15	91.24		0.23	
GLAD-126-R-2009	16.06	74.81	9.14			
GLAD-128-R-2009	24.65	70.65	4.72			
GLAD-129-R-2009	18.34	78.50	3.17			

Table Appendix-3. (Continued)

Site	% Urban	% Agricultural	% Forest	% Wetlands	% Water	% Other
2009 (Continued)						
HUNT-133-R-2009			100.02			
HUNT-225-R-2009	3.19	2.24	94.57		0.02	
ISRA-129-R-2009	52.09	35.63	12.05		0.25	
ISRA-226-R-2009	14.35	63.60	22.01		0.05	
LCCS-125-R-2009		70.11	29.94			
LCCS-226-R-2009	9.90	65.06	24.76		0.33	
LINL-126-R-2009	31.00	28.61	40.40			
LINL-423-R-2009	17.13	53.50	28.83	0.06	0.42	0.07
LINL-429-R-2009	14.86	58.13	26.79	0.08	0.09	0.07
LINU-121-R-2009		97.95	2.05			
LINU-134-R-2009	0.51	96.18	3.32			
LIPI-128-R-2009	11.05	87.69	1.27			
LIPI-234-R-2009	4.54	83.19	12.28			
MIDD-124-R-2009	23.18	44.51	32.34			
MIDD-126-R-2009	5.37	37.64	57.02			
MIDD-135-R-2009	9.88	11.98	78.12		0.05	
MODS-121-R-2009	4.91	92.63	2.50			
MODS-124-R-2009	25.94	72.24	1.85			
OWEN-122-R-2009	1.33	7.02	91.59		0.07	
OWEN-224-R-2009	10.99	47.51	41.29		0.22	
POTD-132-R-2009	24.44	75.60				
POTD-133-R-2009	16.63	23.93	59.48			
POTD-328-R-2009	16.19	63.92	18.80		0.10	1.04
TOMS-224-R-2009	6.85	40.53	50.36	1.65	0.42	0.13
TOMS-234-R-2009	4.43	75.24	20.00		0.18	0.01
TOMS-325-R-2009	8.94	30.68	60.16	0.02	0.06	
TUSC-121-R-2009			100.03			
TUSC-231-R-2009	37.32	16.30	46.41			
TUSC-432-R-2009	8.52	17.73	73.64		0.14	
2010						
BALL-148-R-2010	44.25	6.12	49.67			
BALL-149-R-2010	38.36	19.12	42.55			
BENN-149-R-2010			100.03			
BENN-150-R-2010	2.21	66.53	31.29			
BENN-440-R-2010	17.30	42.14	40.42		0.08	0.08
BUSL-137-R-2010	3.71	83.30	12.86			0.15
BUSL-341-R-2010	32.34	36.70	30.21		0.08	0.69
BUSU-141-R-2010	96.18	3.72	0.12			
BUSU-149-R-2010	83.06	9.33	7.62			
BUSU-236-R-2010	42.98	38.50	17.98		0.55	
CARR-141-R-2010	92.95	1.41	4.78		0.89	
CARR-143-R-2010	33.94	7.18	58.91			
CATO-144-R-2010	1.51	45.99	52.54			
CATO-238-R-2010	1.85	91.95	6.24			
CATO-337-R-2010	10.09	36.23	53.66		0.05	
FISH-144-R-2010	10.09	85.52	4.41			
FISH-243-R-2010	8.58	13.51	77.74		0.19	
GLAD-139-R-2010	14.82	76.95	8.24			
GLAD-141-R-2010	4.22	81.49	14.30			
HUNT-144-R-2010			100.02			
HUNT-249-R-2010	4.35	8.49	86.35		0.83	
HUNT-539-R-2010	10.76	27.64	61.39		0.22	
ISRA-137-R-2010	16.79	53.75	29.47			

Table Appendix-3. (Continued)

Site	% Urban	% Agricultural	% Forest	% Wetlands	% Water	% Other
2010 (Continued)						
ISRA-142-R-2010	4.61	68.45	26.95			
ISRA-149-R-2010	17.19	82.74	0.08			
LCCS-241-R-2010	8.25	69.89	21.46		0.45	
LCCS-245-R-2010	9.81	66.97	22.91		0.37	
LCCS-248-R-2010	9.31	68.65	21.66		0.42	
LINL-137-R-2010	15.11	62.53	22.22		0.14	
LINL-138-R-2010	86.36	9.35	4.31			
LINU-142-R-2010	8.87	82.95	8.18			
LINU-145-R-2010	14.72	75.61	9.68			
LINU-239-R-2010	13.43	45.83	40.35	0.29	0.11	
LIPI-145-R-2010	16.48	39.39	44.14			
LIPI-149-R-2010	6.18	86.74	7.09			
LIPI-150-R-2010	4.76	80.67	14.58			
MIDD-136-R-2010	8.97	7.85	83.13		0.08	
MIDD-338-R-2010	8.85	32.42	58.69		0.07	
MODS-140-R-2010	14.35	81.81	3.87			
MODS-245-R-2010	25.17	65.64	9.15		0.07	
MODS-246-R-2010	24.59	66.96	8.37		0.11	
OWEN-145-R-2010	15.04	3.89	81.08			
OWEN-147-R-2010	1.41	18.99	79.58		0.03	
OWEN-348-R-2010	5.86	26.21	67.87		0.07	
POTD-139-R-2010	9.86	84.15	6.02			
POTD-141-R-2010		14.03	86.01			
TOMS-241-R-2010	6.08	76.43	17.42		0.08	
TOMS-337-R-2010	0.20	15.96	81.74	0.13	0.85	
TUSC-143-R-2010	1.19		97.60		1.24	
TUSC-150-R-2010	1.43		97.13		1.48	

Appendix-9

Site	Dissolved Organic Carbon	Turbidity	Total Phosphorus	Total Nitrogen	Ortho-phosphate	Ammonia-N	Nitrite-N	Nitrite-N + Nitrate-N	Nitrate-N	TKN
2007										
BENN-103-R-2007	1.3853	8.9501	0.0183	0.0103	10.8655	0.0259	0.0062	5	8.9684	1.8971
BENN-106-R-2007	0.241	0.005	0.0019	0.0027	0.1294	0.0309	0.0033	16	0.0069	0.1225
BENN-108-R-2007	1.8207	0.0371	0.0019	0.0042	0.1235	0.0059	0.0012	1	0.039	0.0845
BENN-111-R-2007	0.3162	6.3114	0.0021	0.002	7.5914	0.0178	0.0012	18	6.3135	1.2779
BENN-113-R-2007	2.8268	0.0502	0.0019	0.0083	0.4675	0.0289	0.0021	36	0.0521	0.4154
BENN-127-R-2007	2.0754	0.0875	0.0019	0.0068	0.2145	0.0171	0.0085	8	0.0894	0.1251
BENN-129-R-2007	2.5641	0.0662	0.0019	0.0043	0.2201	0.0111	0.0031	5	0.0681	0.152
BENN-130-R-2007	1.7434	4.609	0.0085	0.0125	4.8532	0.0336	0.0245	18	4.6175	0.2357
BENN-132-R-2007	2.4517	0.0752	0.0019	0.0082	0.2494	0.017	0.003	13	0.0771	0.1723
BENN-133-R-2007	1.3379	4.1055	0.0042	0.0062	4.3823	0.0127	0.0057	4	4.1097	0.2726
BENN-201-R-2007	1.7895	3.9375	0.0107	0.01	4.2115	0.0147	0.0035	4	3.9482	0.2633
BENN-215-R-2007	0.6806	1.6835	0.0019	0.0071	1.7937	0.0188	0.0132	11	1.6854	0.1083
BENN-217-R-2007	2.0386	3.1203	0.0116	0.0203	3.4711	0.0331	0.0129	18	3.1319	0.3392
BENN-218-R-2007	1.7678	3.3231	0.0095	0.0116	3.5625	0.0219	0.0114	4	3.3326	0.2299
BENN-225-R-2007	1.6475	7.9969	0.0037	0.0116	9.8395	0.0116	0.0012	9	8.0006	1.8389
CATO-103-R-2007	1.7958	1.8419	0.0104	0.0108	2.1426	0.0446	0.0076	23	1.8523	0.2903
CATO-108-R-2007	1.0529	2.7603	0.005	0.0072	2.898	0.016	0.0039	6	2.7653	0.1327
CATO-110-R-2007	0.9409	8.2426	0.007	0.0125	10.1069	0.08	0.043	18	8.2496	1.8573
CATO-112-R-2007	0.8446	4.5473	0.0028	0.0205	4.7668	0.0838	0.0141	50	4.5501	0.2167
CATO-116-R-2007	1.3505	1.6035	0.0019	0.0051	1.7386	0.0516	0.0473	8	1.6054	0.1332
CATO-117-R-2007	1.1616	0.974	0.0031	0.0138	1.1176	0.0578	0.0179	25	0.9771	0.1405
CATO-118-R-2007	0.5919	3.5956	0.0055	0.0099	3.7785	0.0217	0.0061	5	3.6011	0.1774
CATO-120-R-2007	0.7658	1.8032	0.0029	0.0104	1.9792	0.0931	0.0555	43	1.8061	0.1731
CATO-121-R-2007	1.4032	3.8259	0.0041	0.0109	4.032	0.0691	0.0521	9	3.83	0.202
CATO-127-R-2007	2.065	0.5423	0.0063	0.0138	0.861	0.0511	0.0031	22	0.5486	0.3124
CATO-205-R-2007	1.2349	0.5235	0.0019	0.0064	0.6478	0.0133	0.0056	3	0.5254	0.1224
CATO-230-R-2007	0.799	1.09	0.0019	0.0048	1.3701	0.0227	0.0119	6	1.0919	0.2782
CATO-302-R-2007	0.9843	4.6951	0.0049	0.0083	5.2951	0.0809	0.0299	127	4.7	0.5951
CATO-428-R-2007	2.0549	2.71	0.0214	0.0147	2.999	0.0295	0.0136	3	2.7314	0.2676
CATO-504-R-2007	1.82	1.0522	0.0135	0.017	1.3104	0.0325	0.0161	5	1.0657	0.2447

Table Appendix-4. (Continued)

Site	Dissolved Organic Carbon	Turbidity	Total Phosphorus	Total Nitrogen	Ortho- phosphate	Ammonia-N	Nitrite-N	Nitrite-N + Nitrate-N	Nitrate-N	TKN
2008										
BALL-102-R-2008	0.9164	2.7293	0.0021	0.0072	2.9827	0.012	0.0109	1	2.7314	0.2513
BALL-105-R-2008	3.591	4.9041	0.0158	0.0129	5.4367	0.0526	0.0112	12	4.9199	0.5168
BENN-101-R-2008	2.3728	0.3081	0.0019	0.0071	0.468	0.0054	0.0032	1	0.31	0.158
BENN-105-R-2008	1.4009	10.3579	0.0109	0.0077	13.3967	0.0143	0.0011	0	10.3688	3.0279
BENN-204-R-2008	0.6532	1.5397	0.002	0.0043	1.7555	0.0054	0.0011	0	1.5417	0.2138
BUSL-107-R-2008	1.359	3.83	0.0074	0.0134	4.3356	0.013	0.0039	3	3.8374	0.4982
BUSL-301-R-2008	1.5772	2.3916	0.0162	0.0106	2.8111	0.0302	0.0101	1	2.4078	0.4033
BUSU-104-R-2008	0.6812	2.8074	0.0041	0.0317	3.0764	0.004	0.0011	3	2.8115	0.2649
BUSU-109-R-2008	0.4796	5.4073	0.0026	0.0118	7.1249	0.0047	0.0011	7	5.4099	1.715
BUSU-206-R-2008	0.8736	3.2307	0.0406	0.0103	3.7632	0.0145	0.0034	0	3.2713	0.4919
CARR-106-R-2008	0.4532	0.8514	0.0019	0.0062	1.0071	0.0037	0.0011	3	0.8533	0.1538
CARR-111-R-2008	1.039	0.2024	0.0019	0.006	0.3279	0.0096	0.0062	2	0.2043	0.1236
CATO-102-R-2008	1.7424	0.3658	0.0019	0.0044	0.5111	0.0055	0.0033	3	0.3677	0.1434
CATO-204-R-2008	1.7582	3.1669	0.0105	0.0134	3.668	0.0349	0.0224	4	3.1774	0.4906
CATO-405-R-2008	1.4703	0.7515	0.015	0.0193	1.4057	0.0341	0.0425	2	0.7665	0.6392
FISH-201-R-2008	1.4411	0.1585	0.0019	0.0028	0.4156	0.0078	0.0011	2	0.1604	0.2552
FISH-203-R-2008	1.3062	0.1174	0.0019	0.0048	0.2235	0.0037	0.0011	0	0.1193	0.1042
GLAD-108-R-2008	5.7597	7.2005	0.0171	0.0207	10.0402	0.2932	0.238	18	7.2176	2.8226
GLAD-109-R-2008	0.9196	9.6673	0.067	0.0118	11.5109	0.0623	0.0095	0	9.7343	1.7766
HUNT-105-R-2008	1.6961	0.617	0.0019	0.0043	0.7233	0.0037	0.0011	1	0.6189	0.1044
HUNT-302-R-2008	1.7722	0.9374	0.0048	0.0065	1.2137	0.0309	0.0273	2	0.9422	0.2715
HUNT-303-R-2008	1.5012	0.6596	0.0048	0.0439	0.8885	0.052	0.0546	1	0.6644	0.2241
ISRA-107-R-2008	1.3891	3.3079	0.011	0.0065	3.7072	0.0155	0.0031	4	3.3189	0.3883
ISRA-109-R-2008	1.9728	0.4123	0.0019	0.01	0.6329	0.0143	0.0011	11	0.4142	0.2187
ISRA-301-R-2008	1.4308	3.0996	0.0079	0.0124	3.404	0.0303	0.0209	7	3.1075	0.2965
LCCS-101-R-2008	1.2993	5.0443	0.0025	0.0106	5.5175	0.0393	0.014	23	5.0468	0.4707
LCCS-103-R-2008	0.3454	4.4568	0.0047	0.0104	4.8617	0.0234	0.0183	12	4.4615	0.4002
LCCS-202-R-2008	1.8492	3.4913	0.008	0.0059	3.9935	0.0152	0.0075	1	3.4993	0.4942
LINL-103-R-2008	1.1072	11.7296	0.0134	0.0153	13.4543	0.1548	0.1347	2	11.743	1.7113
LINL-104-R-2008	0.7995	2.4143	0.0019	0.0055	2.6912	0.0157	0.0114	3	2.4162	0.275
LINU-111-R-2008	1.1971	3.3315	0.006	0.0107	3.673	0.0169	0.0054	2	3.3375	0.3355
LINU-405-R-2008	1.2552	3.2591	0.007	0.009	3.5906	0.0187	0.0066	3	3.2661	0.3245
LINU-407-R-2008	1.272	3.2759	0.0075	0.0079	3.6738	0.0192	0.0052	4	3.2834	0.3904
LIPI-102-R-2008	1.2754	6.4968	0.0175	0.0157	7.8896	0.0961	0.0323	17	6.5143	1.3753

Table Appendix-4. (Continued)

Site	Dissolved Organic Carbon	Turbidity	Total Phosphorus	Total Nitrogen	Ortho-phosphate	Ammonia-N	Nitrite-N	Nitrite-N + Nitrate-N	Nitrate-N	TKN
2008 (Continued)										
LIPI-201-R-2008	1.2801	4.7974	0.0085	0.0099	5.3248	0.0465	0.0306	5	4.8059	0.5189
LIPI-307-R-2008	0.8463	4.9652	0.015	0.0158	6.0589	0.0201	0.0096	4	4.9802	1.0787
MIDD-101-R-2008	1.3005	1.1284	0.0051	0.0111	1.4042	0.0317	0.0248	3	1.1335	0.2707
MIDD-109-R-2008	1.3247	1.1543	0.0019	0.0053	1.3122	0.004	0.0035	2	1.1562	0.156
MODS-108-R-2008	0.3343	8.8748	0.0064	0.0117	11.9598	0.0269	0.0011	19	8.8812	3.0786
MODS-110-R-2008	1.1695	4.4503	0.0154	0.0128	5.1143	0.0129	0.0035	3	4.4657	0.6486
MODS-115-R-2008	1.1784	5.2885	0.0131	0.0176	6.6875	0.0284	0.0063	8	5.3016	1.3859
OWEN-101-R-2008	2.4298	1.7633	0.0058	0.0147	2.2093	0.0414	0.0271	2	1.7691	0.4402
OWEN-302-R-2008	1.1892	0.8961	0.0035	0.0061	1.1253	0.0078	0.004	1	0.8996	0.2257
OWEN-309-R-2008	1.1939	0.9034	0.0029	0.0071	1.1192	0.0075	0.0036	1	0.9063	0.2129
POTD-205-R-2008	1.7949	2.8798	0.0111	0.0077	3.1632	0.0334	0.0178	3	2.8909	0.2723
POTD-301-R-2008	1.5474	4.6073	0.0181	0.0101	5.19	0.0306	0.0132	3	4.6254	0.5646
TOMS-202-R-2008	0.9113	0.8697	0.0019	0.004	1.084	0.0037	0.0011	1	0.8716	0.2124
TOMS-401-R-2008	2.0276	1.2025	0.004	0.0113	1.4954	0.0202	0.0167	3	1.2065	0.2889
TUSC-107-R-2008	3.5914	1.6082	0.002	0.007	2.0422	0.0132	0.0029	3	1.6102	0.432
TUSC-406-R-2008	5.3211	1.0809	0.0048	0.0115	1.7101	0.0687	0.0168	48	1.0857	0.6244
2009										
BALL-123-R-2009	2.0157	1.7438	0.0408	0.4074	2.2776	0.0726	0.0486	4	1.7846	0.493
BALL-126-R-2009	1.8405	2.3989	0.0052	0.0117	2.4781	0.0199	0.0043	2	2.4041	0.074
BALL-127-R-2009	2.3418	0.512	0.0034	0.008	0.7582	0.0289	0.0011	13	0.5154	0.2428
BENN-130-R-2009	1.1442	2.9346	0.0055	0.0116	2.9529	0.0247	0.0083	4	2.9401	0.0128
BENN-427-R-2009	1.182	2.9166	0.0047	0.0121	2.9282	0.0219	0.008	5	2.9213	0.0069
BUSL-322-R-2009	1.4754	2.0009	0.028	0.0364	2.1871	0.0554	0.0255	4	2.0289	0.1582
BUSL-324-R-2009	1.6288	2.1358	0.0209	0.0244	2.2782	0.047	0.0221	3	2.1567	0.1215
BUSL-330-R-2009	1.5663	1.9954	0.0288	0.0406	2.2708	0.0683	0.0344	5	2.0242	0.2466
BUSU-126-R-2009	0.2358	4.0751	0.0046	0.0125	4.2265	0.0281	0.0083	11	4.0797	0.1468
BUSU-227-R-2009	1.0459	2.1382	0.014	0.0128	2.2302	0.034	0.0095	2	2.1522	0.078
CARR-129-R-2009	2.1718	0.6762	0.0019	0.0146	0.8144	0.0272	0.0011	10	0.6781	0.1363
CARR-135-R-2009	0.9061	0.3742	0.0019	0.0057	0.5661	0.0246	0.0138	23	0.3761	0.19
CARR-222-R-2009	1.7765	2.6438	0.0086	0.0334	2.7932	0.0485	0.0094	12	2.6524	0.1408
CATO-132-R-2009	1.221	2.2519	0.0019	0.0082	2.3324	0.0409	0.0098	6	2.2538	0.0786
CATO-135-R-2009	1.2935	0.6311	0.0019	0.0143	0.7543	0.0252	0.0098	3	0.633	0.1213
FISH-222-R-2009	1.4644	0.1064	0.0019	0.0093	0.2519	0.0194	0.0011	4	0.1083	0.1436
FISH-224-R-2009	1.3772	0.2147	0.0019	0.0099	0.3899	0.0237	0.0056	4	0.2166	0.1733

Table Appendix-4. (Continued)

Site	Dissolved Organic Carbon	Turbidity	Total Phosphorus	Total Nitrogen	Ortho- phosphate	Ammonia-N	Nitrite-N	Nitrite-N + Nitrate-N	Nitrate-N	TKN
2009 (Continued)										
FISH-226-R-2009	1.0406	0.09	0.0019	0.0061	0.2372	0.018	0.0011	3	0.0919	0.1453
GLAD-126-R-2009	4.0775	8.6782	0.051	0.1636	9.2869	0.1291	0.0826	7	8.7292	0.5577
GLAD-128-R-2009	2.2252	6.8248	0.056	0.0277	8.918	0.0569	0.0011	13	6.8808	2.0372
GLAD-129-R-2009	1.0961	6.188	0.029	0.0125	6.58	0.0611	0.0066	0	6.217	0.363
HUNT-133-R-2009	0.5734	0.1834	0.0019	0.0039	0.2384	0.0071	0.0011	2	0.1853	0.0531
HUNT-225-R-2009	0.8767	0.1234	0.0019	0.0039	0.1793	0.008	0.0011	1	0.1253	0.054
ISRA-129-R-2009	0.5704	5.5535	0.0231	0.0088	5.9239	0.02	0.0011	15	5.5766	0.3473
ISRA-226-R-2009	1.4164	2.6809	0.0179	0.0255	2.7446	0.035	0.0076	11	2.6988	0.0458
LCCS-125-R-2009	2.7901	3.5399	0.0091	0.0232	3.625	0.081	0.0515	9	3.549	0.076
LCCS-226-R-2009	2.3956	2.9949	0.0074	0.0097	3.0731	0.0519	0.0234	7	3.0023	0.0708
LINL-126-R-2009	0.3464	8.743	0.0119	0.018	8.9928	0.071	0.0101	19	8.7549	0.2379
LINL-423-R-2009	2.416	1.6882	0.0173	0.0193	2.0257	0.0379	0.0011	11	1.7055	0.3202
LINL-429-R-2009	1.4994	2.6175	0.0204	0.0305	2.7936	0.0841	0.0111	36	2.6379	0.1557
LINU-121-R-2009	0.7861	3.1304	0.0186	0.0566	3.2412	0.0493	0.0071	19	3.149	0.0922
LINU-134-R-2009	0.8504	5.3231	0.0103	0.0188	5.475	0.0211	0.004	3	5.3334	0.1416
LIPI-128-R-2009	3.4151	4.7367	0.0105	0.0179	5.0531	0.0805	0.0437	9	4.7472	0.3059
LIPI-234-R-2009	0.9432	4.0869	0.0194	0.038	4.1212	0.0726	0.0166	21	4.1063	0.0149
MIDD-124-R-2009	0.7534	0.7748	0.005	0.0165	0.9113	0.0327	0.0076	7	0.7798	0.1315
MIDD-126-R-2009	1.3369	0.5898	0.0019	0.0081	0.682	0.0101	0.0057	5	0.5917	0.0903
MIDD-135-R-2009	2.0346	0.2767	0.0019	0.0052	0.3927	0.0083	0.0022	2	0.2786	0.1141
MODS-121-R-2009	0.7207	15.0844	0.0091	0.0204	15.5094	0.1412	0.0083	48	15.0935	0.4159
MODS-124-R-2009	0.5053	11.6655	0.0146	0.0208	12.5882	0.0201	0.0011	19	11.6801	0.9081
OWEN-122-R-2009	1.3504	0.0843	0.0019	0.0077	0.1907	0.0158	0.0046	3	0.0862	0.1045
OWEN-224-R-2009	2.3109	0.6005	0.0082	0.0162	0.8399	0.0242	0.0066	5	0.6087	0.2312
POTD-132-R-2009	6.4136	3.7437	0.0197	0.0309	4.3554	0.0903	0.0465	18	3.7634	0.592
POTD-133-R-2009	2.3124	0.7194	0.0046	0.0136	0.9997	0.0499	0.007	21	0.724	0.2757
POTD-328-R-2009	2.0567	4.876	0.0329	0.0587	5.3673	0.0643	0.0183	14	4.9089	0.4584
TOMS-224-R-2009	5.0975	0.01	0.0019	0.0118	0.4499	0.0349	0.0073	4	0.0119	0.438
TOMS-234-R-2009	5.7913	2.8383	0.0314	0.0296	3.3356	0.0894	0.0516	5	2.8697	0.4659
TOMS-325-R-2009	1.1092	0.3277	0.0019	0.0059	0.4176	0.0157	0.0102	5	0.3296	0.088
TUSC-121-R-2009	0.7365	0.0162	0.0019	0.0047	0.084	0.0096	0.0011	2	0.0181	0.0659
TUSC-231-R-2009	1.5292	1.4865	0.0048	0.0152	1.6032	0.0203	0.0062	4	1.4913	0.1119
TUSC-432-R-2009	1.5315	0.1815	0.0044	0.0178	0.3514	0.0291	0.0155	4	0.1859	0.1655

Table Appendix-4. (Continued)

Site	Dissolved Organic Carbon	Turbidity	Total Phosphorus	Total Nitrogen	Ortho- phosphate	Ammonia-N	Nitrite-N	Nitrite-N + Nitrate-N	Nitrate-N	TKN
2010										
BALL-148-R-2010	1.496	1.401	0.0019	0.0046	1.5511	0.0079	0.0036	1	1.4029	0.1482
BALL-149-R-2010	1.2501	2.5954	0.0023	0.0033	2.6243	0.008	0.0039	1	2.5977	0.0266
BENN-149-R-2010	1.7741	0.0256	0.0019	0.0024	0.1761	0.0094	0.0011	2	0.0275	0.1486
BENN-150-R-2010	0.9553	1.4076	0.0026	0.0028	1.5365	0.0182	0.0054	4	1.4102	0.1263
BENN-440-R-2010	1.3591	2.813	0.0076	0.0047	2.8168	0.0146	0.0011	4	2.8206	-0.0038
BUSL-137-R-2010	3.042	1.6405	0.0245	0.0733	2.3166	0.0504	0.0037	4	1.665	0.6516
BUSL-341-R-2010	1.2197	3.0152	0.0147	0.1668	3.3754	0.022	0.0098	2	3.0299	0.3455
BUSU-141-R-2010	0.5691	5.1546	0.0019	0.0054	5.4942	0.0069	0.0011	2	5.1565	0.3377
BUSU-149-R-2010	0.9909	1.784	0.004	0.0211	1.9432	0.0117	0.0025	3	1.788	0.1552
BUSU-236-R-2010	0.9517	3.5109	0.0079	0.0192	3.7603	0.0136	0.0011	7	3.5188	0.2415
CARR-141-R-2010	1.2784	1.9512	0.0043	0.0217	2.1242	0.0222	0.0011	3	1.9555	0.1687
CARR-143-R-2010	2.3049	0.7276	0.0019	0.0059	0.9084	0.0105	0.0011	5	0.7295	0.1789
CATO-144-R-2010	2.7482	0.5518	0.0037	0.0112	0.8939	0.0641	0.0058	26	0.5555	0.3384
CATO-238-R-2010	1.1376	5.9478	0.0088	0.0052	6.4199	0.0476	0.0298	5	5.9566	0.4633
CATO-337-R-2010	1.7072	0.6601	0.0026	0.0046	0.84	0.0093	0.0011	1	0.6627	0.1773
FISH-144-R-2010	6.9932	0.4838	0.0047	0.027	1.3138	0.0915	0.0137	20	0.4885	0.8253
FISH-243-R-2010	3.0552	0.2586	0.0037	0.0069	0.5547	0.0353	0.0059	11	0.2623	0.2924
GLAD-139-R-2010	4.4631	8.2854	0.0261	0.0295	9.678	0.1496	0.0896	4	8.3115	1.3665
GLAD-141-R-2010	4.5137	2.4351	0.0075	0.0075	2.9199	0.1488	0.1109	10	2.4426	0.4773
HUNT-144-R-2010	0.7729	0.134	0.0019	0.0043	0.2168	0.0087	0.0011	3	0.1359	0.0809
HUNT-249-R-2010	1.4096	0.5274	0.0019	0.0068	0.6538	0.0108	0.0011	1	0.5293	0.1245
HUNT-539-R-2010	2.2417	0.5274	0.0035	0.0108	0.7898	0.031	0.0033	12	0.5309	0.2589
ISRA-137-R-2010	1.046	1.9383	0.0033	0.0021	2.1201	0.0152	0.0011	9	1.9416	0.1785
ISRA-142-R-2010	2.6669	1.5162	0.0038	0.0059	1.9169	0.0345	0.0046	10	1.52	0.3969
ISRA-149-R-2010	5.224	2.0852	0.0058	0.0143	2.7239	0.0603	0.0215	9	2.091	0.6329
LCCS-241-R-2010	2.3311	3.6903	0.0241	0.0138	3.9182	0.0372	0.0115	3	3.7144	0.2038
LCCS-245-R-2010	2.1239	2.9974	0.025	0.0121	3.1904	0.0302	0.0053	2	3.0224	0.168
LCCS-248-R-2010	2.5475	3.364	0.0221	0.0121	3.6241	0.0411	0.0129	4	3.3861	0.238
LINL-137-R-2010	0.8401	3.4528	0.0059	0.0034	3.7112	0.0325	0.0048	7	3.4587	0.2525
LINL-138-R-2010	1.275	2.393	0.0026	0.0043	2.4171	0.0087	0.0011	2	2.3956	0.0215
LINU-142-R-2010	2.9163	1.684	0.0205	0.2766	2.4048	0.3874	0.2412	3	1.7045	0.7003
LINU-145-R-2010	1.65	2.8511	0.0255	0.0508	3.2028	0.161	0.0808	2	2.8766	0.3262
LINU-239-R-2010	0.7799	2.5475	0.0019	0.0026	2.5502	0.0101	0.0011	4	2.5494	0.0008
LIPI-145-R-2010	0.8691	2.9556	0.0032	0.0057	2.9727	0.0103	0.0011	3	2.9588	0.0139

Table Appendix-4. (Continued)

Site	Dissolved Organic Carbon	Turbidity	Total Phosphorus	Total Nitrogen	Ortho- phosphate	Ammonia-N	Nitrite-N	Nitrite-N + Nitrate-N	Nitrate-N	TKN
2010(Continued)										
LIPI-149-R-2010	2.1819	4.8771	0.0515	0.0177	5.3627	0.2187	0.1689	6	4.9286	0.4341
LIPI-150-R-2010	2.2049	3.2637	0.0282	0.0135	3.5063	0.0671	0.0322	7	3.2919	0.2144
MIDD-136-R-2010	1.9466	0.2404	0.0019	0.0028	0.3948	0.007	0.0011	2	0.2423	0.1525
MIDD-338-R-2010	2.1041	0.5824	0.0027	0.0067	0.7397	0.0121	0.0026	1	0.5851	0.1546
MODS-140-R-2010	1.2514	7.5155	0.0096	0.0049	8.3521	0.0214	0.0042	1	7.5251	0.827
MODS-245-R-2010	0.6669	6.157	0.0084	0.0101	6.8272	0.0258	0.0011	11	6.1654	0.6618
MODS-246-R-2010	0.704	6.3019	0.0088	0.0058	7.1603	0.024	0.0011	13	6.3107	0.8496
OWEN-145-R-2010	1.1033	0.54	0.0019	0.002	0.6466	0.0073	0.0011	1	0.5419	0.1047
OWEN-147-R-2010	1.1695	0.0281	0.0019	0.002	0.1766	0.0104	0.0011	1	0.03	0.1466
OWEN-348-R-2010	1.2423	0.6483	0.0031	0.0049	0.7991	0.0098	0.0035	1	0.6514	0.1477
POTD-139-R-2010	1.4643	3.7858	0.0094	0.005	3.9297	0.0273	0.0061	2	3.7952	0.1345
POTD-141-R-2010	1.295	0.5628	0.0019	0.0029	0.6959	0.0103	0.003	4	0.5647	0.1312
TOMS-241-R-2010	3.0556	1.2347	0.0131	0.0123	1.5095	0.0291	0.0068	5	1.2478	0.2617
TOMS-337-R-2010	2.0502	0.3769	0.0064	0.0059	0.5734	0.0259	0.0011	3	0.3833	0.1901
TUSC-143-R-2010	0.8719	0.0401	0.0019	0.002	0.1158	0.0048	0.0011	0	0.042	0.0738
TUSC-150-R-2010	1.0774	0.0284	0.0019	0.002	0.0887	0.0043	0.0011	0	0.0303	0.0584

Table Appendix-5. Water quality thresholds (mg/l) for dissolved oxygen and nutrients measured at sites sampled in the FCSS (Southerland et al. 2005)

Parameter	Low	Moderate	High
Dissolved Oxygen	< 3	3 – 5	> 5
Nitrate-N	< 1.0	1.0 – 5.0	> 5.0
Nitrite-N	< 0.0025	0.0025 – 0.01	> 0.01
Ammonia-N	<0.03	0.03 – 0.07	> 0.07
Total Nitrogen	< 1.5	1.5 – 7.0	> 7.0
Total Phosphorus	< 0.025	0.025 – 0.070	> 0.070
Ortho-phosphate	< 0.008	0.008 – 0.03	> 0.03

Table Appendix-6. Bank Erosion Scores and Riparian Buffer Widths at the sites sampled in the 2007-2010 FCSS

Site	Erosion Severity Left	Erosion Severity Right	Riparian Width Left (m)	Riparian Width Right (m)	Riparian Width Sum (m) (Sum of Left and Right)
2007					
BENN-130-R-2007	3	3	10	7	17
BENN-217-R-2007	3	3	25	50	75
BENN-218-R-2007	2	2	10	50	60
CATO-108-R-2007	1	1	5	5	10
CATO-117-R-2007	1	1	50	50	100
CATO-121-R-2007	1	1	10	50	60
CATO-127-R-2007	1	1	50	50	100
BENN-103-R-2007	2	2	50	25	75
BENN-111-R-2007	3	3	40	35	75
BENN-201-R-2007	3	3	50	50	100
BENN-215-R-2007	2	1	12	50	62
CATO-103-R-2007	3	3	10	5	15
CATO-110-R-2007	2	1	50	50	100
CATO-428-R-2007	1	2	50	50	100
CATO-504-R-2007	3	2	50	50	100
BENN-108-R-2007	0	0	50	50	100
BENN-113-R-2007	1	1	50	50	100
BENN-127-R-2007	1	1	50	50	100
BENN-132-R-2007	1	2	50	50	100
CATO-112-R-2007	1	1	50	50	100
CATO-118-R-2007	1	1	3	5	8
CATO-120-R-2007	1	1	8	20	28
CATO-302-R-2007	2	2	50	50	100
BENN-106-R-2007	0	0	50	50	100
BENN-129-R-2007	1	1	50	50	100
BENN-133-R-2007	2	1	50	50	100
BENN-225-R-2007	0	0	50	50	100
CATO-116-R-2007	3	3	50	15	65
CATO-205-R-2007	1	3	50	50	100
CATO-230-R-2007	2	2	50	2	52
2008					
LINL-103-R-2008	2	1	15	0	15
FISH-201-R-2008	1	1	50	25	75
FISH-203-R-2008	1	1	50	0	50
HUNT-302-R-2008	1	1	10	10	20
TOMS-202-R-2008	1	1	50	50	100
TOMS-401-R-2008	1	3	50	2	52
HUNT-303-R-2008	1	2	50	50	100
ISRA-301-R-2008	3	3	0	0	0
LIPI-201-R-2008	3	1	20	2	22
BENN-101-R-2008	2	2	30	50	80
BUSL-107-R-2008	2	1	2	1	3
POTD-205-R-2008	3	3	0	0	0
POTD-301-R-2008	3	2	0	0	0
BALL-102-R-2008	1	1	50	50	100

Table Appendix-6. (Continued)

Site	Erosion Severity Left	Erosion Severity Right	Riparian Width Left (m)	Riparian Width Right (m)	Riparian Width Sum (m) (Sum of Left and Right)
2008 (Continued)					
LCCS-101-R-2008	1	2	50	50	100
LCCS-103-R-2008	0	0	10	10	20
LCCS-202-R-2008	3	3	50	50	100
BALL-105-R-2008	3	1	50	50	100
CATO-204-R-2008	3	0	50	50	100
GLAD-108-R-2008	2	3	50	50	100
TUSC-107-R-2008	1	1	50	50	100
TUSC-406-R-2008	2	2	50	50	100
LINL-104-R-2008	3	1	50	20	70
LINU-111-R-2008	0	0	50	50	100
LINU-405-R-2008	1	3	50	50	100
LINU-407-R-2008	3	1	20	50	70
CATO-102-R-2008	1	1	50	50	100
HUNT-105-R-2008	1	1	50	50	100
MIDD-101-R-2008	1	1	3	5	8
MIDD-109-R-2008	1	0	1	1	2
BENN-105-R-2008	0	0	50	50	100
BENN-204-R-2008	1	2	50	50	100
BUSL-301-R-2008	1	1	50	50	100
BUSU-206-R-2008	1	3	50	50	100
GLAD-109-R-2008	0	1	5	2	7
OWEN-302-R-2008	2	2	50	50	100
OWEN-309-R-2008	3	2	0	20	20
CARR-106-R-2008	0	1	50	10	60
CATO-405-R-2008	1	3	50	5	55
OWEN-101-R-2008	1	0	10	10	20
BUSU-104-R-2008	2	1	50	50	100
BUSU-109-R-2008	1	1	50	50	100
MODS-108-R-2008	1	1	50	50	100
ISRA-107-R-2008	1	2	50	50	100
ISRA-109-R-2008	2	2	50	50	100
LIPI-102-R-2008	1	1	0	0	0
LIPI-307-R-2008	2	1	0	0	0
CARR-111-R-2008	1	1	50	50	100
MODS-110-R-2008	3	3	50	50	100
MODS-115-R-2008	3	3	5	10	15
2009					
BALL-126-R-2009	2	2	50	50	100
CATO-132-R-2009	0	0	50	50	100
CATO-135-R-2009	1	3	5	10	15
CARR-129-R-2009	2	1	50	50	100
CARR-135-R-2009	1	3	50	50	100
CARR-222-R-2009	2	3	50	50	100
BALL-123-R-2009	3	3	0	0	0
BALL-127-R-2009	3	1	50	50	100
HUNT-225-R-2009	1	0	30	50	80

Table Appendix-6. (Continued)

Site	Erosion Severity Left	Erosion Severity Right	Riparian Width Left (m)	Riparian Width Right (m)	Riparian Width Sum (m) (Sum of Left and Right)
2009 (Continued)					
ISRA-129-R-2009	1	1	0	0	0
LCCS-125-R-2009	2	2	5	0	5
LCCS-226-R-2009	3	2	50	50	100
LIPI-128-R-2009	1	1	5	3	8
LIPI-234-R-2009	0	1	50	5	55
MIDD-126-R-2009	1	2	20	50	70
MIDD-135-R-2009	1	1	50	50	100
TUSC-432-R-2009	3	2	50	50	100
GLAD-126-R-2009	1	1	50	50	100
GLAD-128-R-2009	1	1	0	0	0
GLAD-129-R-2009	1	0	0	0	0
HUNT-133-R-2009	1	1	50	50	100
BENN-130-R-2009	2	3	50	50	100
BENN-427-R-2009	3	3	50	50	100
BUSL-324-R-2009	3	3	50	45	95
BUSU-126-R-2009	3	3	50	50	100
BUSU-227-R-2009	1	3	50	50	100
LINL-126-R-2009	1	1	30	40	70
BUSL-322-R-2009	2	2	45	50	95
BUSL-330-R-2009	3	3	30	50	80
LINL-423-R-2009	3	3	50	50	100
LINL-429-R-2009	3	3	50	50	100
LINU-134-R-2009	0	0	50	50	100
TOMS-224-R-2009	0	0	35	50	85
TOMS-234-R-2009	1	2	20	15	35
TOMS-325-R-2009	0	0	50	50	100
MODS-121-R-2009	1	1	1	1	2
MODS-124-R-2009	2	1	50	50	100
OWEN-224-R-2009	1	1	50	50	100
POTD-132-R-2009	2	2	30	5	35
POTD-328-R-2009	1	2	50	50	100
TUSC-121-R-2009	1	1	50	50	100
TUSC-231-R-2009	2	2	5	5	10
FISH-222-R-2009	1	1	10	5	15
FISH-224-R-2009	1	1	5	7	12
FISH-226-R-2009	2	3	35	35	70
ISRA-226-R-2009	3	3	50	50	100
LINU-121-R-2009	2	2	0	0	0
MIDD-124-R-2009	1	1	4	3	7
OWEN-122-R-2009	2	1	50	20	70
POTD-133-R-2009	1	1	8	7	15

Table Appendix-6. (Continued)

Site	Erosion Severity Left	Erosion Severity Right	Riparian Width Left (m)	Riparian Width Right (m)	Riparian Width Sum (m) (Sum of Left and Right)
2010					
GLAD-139-R-2010	2	1	50	50	100
BALL-148-R-2010	1	0	20	50	70
BALL-149-R-2010	2	1	50	30	80
BUSL-341-R-2010	3	1	50	50	100
GLAD-141-R-2010	1	1	50	50	100
ISRA-137-R-2010	2	2	50	50	100
BUSU-141-R-2010	2	2	10	50	60
FISH-144-R-2010	1	1	50	50	100
FISH-243-R-2010	1	1	5	50	55
ISRA-142-R-2010	1	1	50	50	100
ISRA-149-R-2010	0	0	0	0	0
BUSL-137-R-2010	1	1	50	50	100
BUSU-149-R-2010	1	1	20	40	60
BUSU-236-R-2010	2	2	50	40	90
LINL-137-R-2010	2	3	0	0	0
LINL-138-R-2010	2	1	50	50	100
LINU-142-R-2010	2	2	50	50	100
LINU-145-R-2010	1	1	20	20	40
LINU-239-R-2010	2	2	5	25	30
MODS-140-R-2010	3	0	3	50	53
MODS-245-R-2010	0	0	50	50	100
MODS-246-R-2010	1	1	20	50	70
POTD-139-R-2010	3	3	5	5	10
POTD-141-R-2010	2	1	50	50	100
LIPI-145-R-2010	1	1	45	15	60
LIPI-149-R-2010	1	2	50	50	100
LIPI-150-R-2010	1	2	10	20	30
TOMS-241-R-2010	1	2	10	30	40
TOMS-337-R-2010	0	0	50	50	100
BENN-149-R-2010	0	0	50	50	100
BENN-150-R-2010	2	2	10	50	60
BENN-440-R-2010	2	3	20	50	70
OWEN-348-R-2010	1	1	50	50	100
TUSC-143-R-2010	0	0	50	50	100
TUSC-150-R-2010	0	1	50	50	100
CATO-144-R-2010	2	1	50	50	100
CATO-238-R-2010	3	2	50	50	100
LCCS-248-R-2010	3	3	50	50	100
CATO-337-R-2010	3	2	50	50	100
LCCS-241-R-2010	3	3	50	50	100
LCCS-245-R-2010	0	3	50	50	100
MIDD-136-R-2010	1	1	50	50	100
MIDD-338-R-2010	0	0	40	30	70
OWEN-145-R-2010	1	2	8	20	28
OWEN-147-R-2010	1	1	50	50	100
HUNT-249-R-2010	0	0	25	50	75

Table Appendix-6. (Continued)

Site	Erosion Severity Left	Erosion Severity Right	Riparian Width Left (m)	Riparian Width Right (m)	Riparian Width Sum (m) (Sum of Left and Right)
2010 (Continued)					
CARR-141-R-2010	2	2	35	40	75
CARR-143-R-2010	2	3	35	35	70
HUNT-539-R-2010	1	1	20	35	55
HUNT-144-R-2010	0	0	50	50	100

The following is derived from MBSS procedures (Roth et al. 2003). A site was considered to have severe erosion if either bank (left or right) is rated a “3” under Erosion Severity score.

Table Appendix-7. Erosion Severity Classes

Erosion Severity Class	Score
None	0
Minimum	1
Moderate	2
Severe	3

Four categories were created to characterize Riparian Buffer Width. The buffer widths from left and right banks were summed together to obtain Riparian Width Sum. Each site’s buffer width was ranked as follows:each site’s buffer width as follows:

Table Appendix-8. Riparian Width Sum classes

Category	Riparian Width Sum
1	$\leq 15\text{ m}$
2	15 m to $\leq 30\text{ m}$
3	30 m to $\leq 60\text{ m}$
4	$> 60\text{ m}$

Table Appendix-9. Impervious Surface Values

Site	% Impervious	Site	% Impervious	Site	% Impervious
2007					
BENN-103-R-2007	2.39	BENN-201-R-2007	5.02	CATO-117-R-2007	1.67
BENN-106-R-2007	1.50	BENN-215-R-2007	1.59	CATO-118-R-2007	2.33
BENN-108-R-2007	1.50	BENN-217-R-2007	5.42	CATO-120-R-2007	1.66
BENN-111-R-2007	9.89	BENN-218-R-2007	5.86	CATO-121-R-2007	2.47
BENN-113-R-2007	1.50	BENN-225-R-2007	5.47	CATO-127-R-2007	1.86
BENN-127-R-2007	1.51	CATO-103-R-2007	3.50	CATO-205-R-2007	2.36
BENN-129-R-2007	1.50	CATO-108-R-2007	13.18	CATO-230-R-2007	4.72
BENN-130-R-2007	12.18	CATO-110-R-2007	2.54	CATO-302-R-2007	2.49
BENN-132-R-2007	1.50	CATO-112-R-2007	8.16	CATO-428-R-2007	2.79
BENN-133-R-2007	8.48	CATO-116-R-2007	8.16	CATO-504-R-2007	4.46
2008					
BALL-102-R-2008	7.72	GLAD-108-R-2008	2.71	LIPI-201-R-2008	2.62
BALL-105-R-2008	11.58	GLAD-109-R-2008	3.11	LIPI-307-R-2008	2.28
BENN-101-R-2008	1.51	HUNT-105-R-2008	2.00	MIDD-101-R-2008	2.78
BENN-105-R-2008	1.90	HUNT-302-R-2008	6.27	MIDD-109-R-2008	3.18
BENN-204-R-2008	2.64	HUNT-303-R-2008	5.78	MODS-108-R-2008	2.62
BUSL-107-R-2008	5.68	ISRA-107-R-2008	2.20	MODS-110-R-2008	1.99
BUSL-301-R-2008	7.68	ISRA-109-R-2008	18.62	MODS-115-R-2008	2.04
BUSU-104-R-2008	5.04	ISRA-301-R-2008	6.99	OWEN-101-R-2008	2.46
BUSU-109-R-2008	8.26	LCCS-101-R-2008	2.95	OWEN-302-R-2008	3.09
BUSU-206-R-2008	9.86	LCCS-103-R-2008	1.75	OWEN-309-R-2008	3.13
CARR-106-R-2008	9.01	LCCS-202-R-2008	4.46	POTD-205-R-2008	20.16
CARR-111-R-2008	2.48	LINL-103-R-2008	5.76	POTD-301-R-2008	14.74
CATO-102-R-2008	1.78	LINL-104-R-2008	1.67	TOMS-202-R-2008	3.15
CATO-204-R-2008	7.08	LINU-111-R-2008	1.95	TOMS-401-R-2008	7.95
CATO-405-R-2008	4.50	LINU-405-R-2008	4.05	TUSC-107-R-2008	6.07
FISH-201-R-2008	2.72	LINU-407-R-2008	4.05	TUSC-406-R-2008	5.47
FISH-203-R-2008	2.08	LIPI-102-R-2008	1.92		
2009					
BALL-123-R-2009	8.83	CATO-132-R-2009	36.47	LCCS-226-R-2009	4.27
BALL-126-R-2009	8.62	CATO-135-R-2009	2.63	LINL-126-R-2009	7.66
BALL-127-R-2009	4.37	FISH-222-R-2009	3.79	LINL-423-R-2009	4.53
BENN-130-R-2009	5.41	FISH-224-R-2009	3.99	LINL-429-R-2009	3.77
BENN-427-R-2009	4.78	FISH-226-R-2009	2.83	LINU-121-R-2009	1.89
BUSL-322-R-2009	8.39	GLAD-126-R-2009	4.92	LINU-134-R-2009	1.92
BUSL-324-R-2009	7.63	GLAD-128-R-2009	3.70	LIPI-128-R-2009	2.68
BUSL-330-R-2009	8.36	GLAD-129-R-2009	3.24	LIPI-234-R-2009	2.45
BUSU-126-R-2009	7.96	HUNT-133-R-2009	1.50	MIDD-124-R-2009	3.42
BUSU-227-R-2009	10.24	HUNT-225-R-2009	1.77	MIDD-126-R-2009	2.09
CARR-129-R-2009	3.67	ISRA-129-R-2009	37.44	MIDD-135-R-2009	2.34
CARR-135-R-2009	2.28	ISRA-226-R-2009	6.92	MODS-121-R-2009	2.24
CARR-222-R-2009	17.00	LCCS-125-R-2009	1.78	MODS-124-R-2009	5.21

Table Appendix-9. (Continued)

Site	% Impervious	Site	% Impervious	Site	% Impervious
2009 (Continued)					
OWEN-122-R-2009	2.28	POTD-328-R-2009	8.39	TUSC-121-R-2009	1.50
OWEN-224-R-2009	3.64	TOMS-224-R-2009	6.25	TUSC-231-R-2009	5.05
POTD-132-R-2009	3.64	TOMS-234-R-2009	3.12	TUSC-432-R-2009	3.15
POTD-133-R-2009	2.84	TOMS-325-R-2009	3.31		
2010					
BALL-148-R-2010	4.84	GLAD-139-R-2010	4.21	LIPI-149-R-2010	2.33
BALL-149-R-2010	6.14	GLAD-141-R-2010	2.96	LIPI-150-R-2010	2.18
BENN-149-R-2010	1.50	HUNT-144-R-2010	1.50	MIDD-136-R-2010	2.28
BENN-150-R-2010	1.93	HUNT-249-R-2010	2.78	MIDD-338-R-2010	2.58
BENN-440-R-2010	4.91	HUNT-539-R-2010	4.40	MODS-140-R-2010	3.40
BUSL-137-R-2010	2.12	ISRA-137-R-2010	2.97	MODS-245-R-2010	19.54
BUSL-341-R-2010	7.83	ISRA-142-R-2010	2.12	MODS-246-R-2010	18.38
BUSU-141-R-2010	8.73	ISRA-149-R-2010	3.12	OWEN-145-R-2010	4.57
BUSU-149-R-2010	7.77	LCCS-241-R-2010	4.29	OWEN-147-R-2010	1.93
BUSU-236-R-2010	5.57	LCCS-245-R-2010	4.37	OWEN-348-R-2010	3.25
CARR-141-R-2010	61.06	LCCS-248-R-2010	4.36	POTD-139-R-2010	3.07
CARR-143-R-2010	11.95	LINL-137-R-2010	3.02	POTD-141-R-2010	1.56
CATO-144-R-2010	2.73	LINL-138-R-2010	9.70	TOMS-241-R-2010	4.22
CATO-238-R-2010	2.01	LINU-142-R-2010	2.80	TOMS-337-R-2010	2.53
CATO-337-R-2010	2.82	LINU-145-R-2010	3.08	TUSC-143-R-2010	2.81
FISH-144-R-2010	2.87	LINU-239-R-2010	4.55	TUSC-150-R-2010	3.06
FISH-243-R-2010	3.90	LIPI-145-R-2010	3.12		

